Cost Reduction of IMM Solar Cells by Recycling Substrates Using Wet Chemical Etching, Phase II

Completed Technology Project (2014 - 2017)

Project Introduction

The goal of the program is to reduce the cost of substrate reclaim for high-efficiency solar cells fabricated by an epitaxial lift-off (ELO) process, and to increase the number of reuse cycles for a given substrate. If successful, this will result in a reduction in the cost of GaAs-based multi-junction solar cells, in which the cost of the substrate accounts for approximately 50% of the total cost. The cost reduction is achieved by introducing a new multi-layer etch-stop structure into a inverted metamorphic (IMM) triple-junction cell. The etch-stop structure is grown between the original GaAs substrate and the ELO release layer, thereby becoming the effective substrate surface after the ELO process. The etch-stop structure prevents pits and surface damage that occur during ELO from damaging the surface of the GaAs substrate. The standard method of reclaiming the GaAs substrate after ELO is to employ chemo-mechanical polishing (CMP) to remove the defect-ridden GaAs surface and chemically polish the underlying GaAs to yield a surface that is suitable for epitaxial growth. The CMP process works but reduces the substrate thickness and causes minor wafer damage itself, which requires further polishing. These factors accumulate, in practice limiting the number of reclaim cycles to 5 - 10 for a given substrate. With the incorporation of the proposed etch-stop structure, the defects are isolated in the etch-stop structure, which can be dissolved by successive selective wet chemical etches to produce the original pristine GaAs surface on a substrate of the original thickness. All mechanical polishing is eliminated in this proposed work, ensuring a constant substrate thickness through repeated substrate reclaim cycles and reducing the estimated cost of the recycling process to <$1 per substrate. The Phase I program demonstrated that this method for substrate reclaim works; in Phase II we will develop the reclaim into an optimized batch process.

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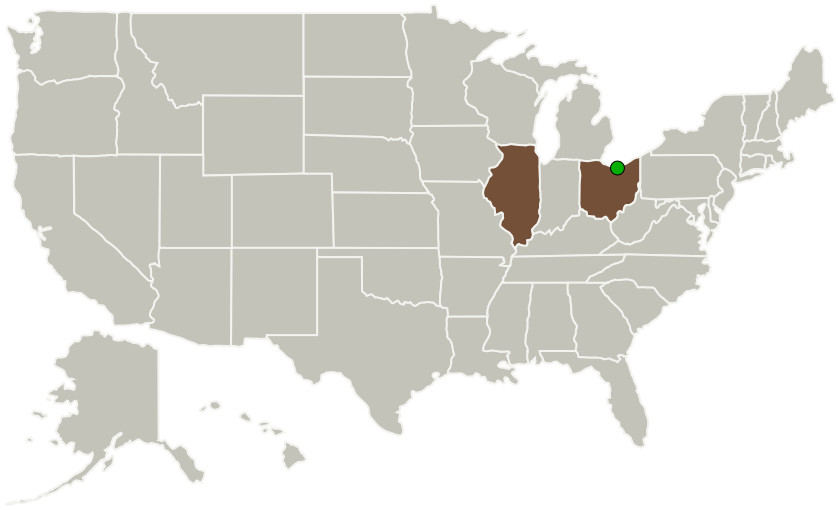
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
MicroLink Devices, Inc.	Lead Organization	Industry Minority-Owned Business	Niles, Illinois
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Illinois	Ohio

Project Transitions

July 2014: Project Start

August 2017: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137503)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

MicroLink Devices, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

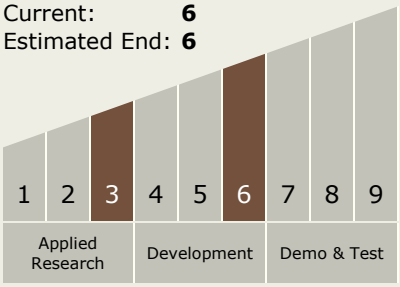
Carlos Torrez

Principal Investigator:

Alex Hains

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



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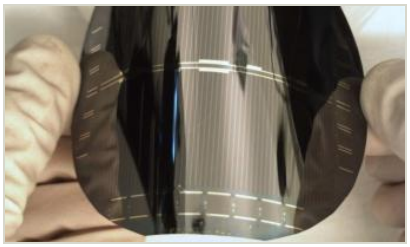
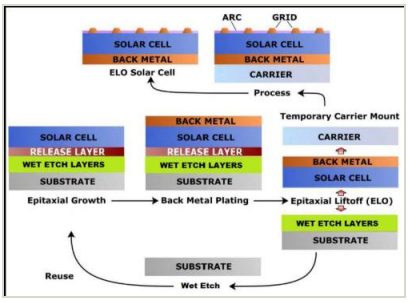
Images



Briefing Chart Image
Cost Reduction of IMM Solar Cells by Recycling Substrates Using Wet Chemical Etching, Phase II
(https://techport.nasa.gov/image/130579)



Final Summary Chart Image
Cost Reduction of IMM Solar Cells by Recycling Substrates Using Wet Chemical Etching, Phase II Project Image
(https://techport.nasa.gov/image/128446)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.1 Photovoltaic

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System